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(71) **Applicant** 000002185
Sony Corporation
6-7-35 Kitashinagawa, Shinagawa-ku, Tokyo

(72) **Inventor** Masanori Tsukamoto
c/o Sony Corporation
6-7-35 Kitashinagawa, Shinagawa-ku, Tokyo

(74) **Attorney** Akira Koike, el al

(54) Invention.

Semiconductor Device

(57) Abstract

Purpose: To prevent hydrogen from being diffused into a gate insulating film with an antireflection film constituted of an SiOn thin film being kept existing by letting a gate electrode include a titanium layer.

Constitution: On an Si substrate 1 where element isolation regions 2 and a gate insulating film 3 are formed, a gate electrode 9 which is constituted of a polysilicon layer 4, a Ti layer 5 and a titanium silicide layer 6 which is put between the other two layers 4 and 5 is formed. On the gate electrode 9, an antireflection film 7 constituted of an SiOn system thin film is deposited in the same pattern as the gate electrode 9. Due to this structure, a hot carrier resistance is remarkably increased compared with the conventional MOS transistor which has no Ti layer 5 in the gate electrode 9. Therefore, even if the antireflection films 7, 18 which are constituted of Sign system thin films are kept existing, hydrogen is prevented by the Ti layer 5 included in the gate electrode 9 from reaching the gate insulating film 3.

Coverage of patent

Claim 1

A semiconductor device whose substrate is constituted of a gate insulation film, a gate electrode. a nitrogen oxide silicon system thin film, and wiring system and its gate electrode contains a titanium layer.

Claim 2

This semiconductor device is characterized by containing a gate insulation film which is made from a silicon oxide system film on the substrate.

Claim 3

This semiconductor device is characterized by containing a gate electrode with a titanium silicide layer.

Claim 4

This semiconductor device is characterized by containing a nitrogen oxide silicon system thin film which is an antireflection film for patterning the gate electrode, and is laminated with the same pattern as the gate electrode.

Claim 5

The nitrogen oxide silicon system thin film in the claim 4 is an antireflection film for patterning the wiring system, and is laminated with the same pattern as the wiring system's.

Explanation

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Industrial use – This semiconductor device has patterning used by a nitrogen oxide silicon system thin film as an antireflection film. Therefore, it prevents from going bad, an electrical characteristic, due to hydrogen diffusion.

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Conventional technique – For wiring materials of semiconductor devices, aluminum (Al) system alloy or high melting point metal silicide are widely used. However, these materials are highly reflecticve and are required to put an antireflection film on the surface of the layers in order to improve the precision of photo lithography. As the design rules of semiconductor devices are regulated in detail, the exposure wavelength to the photo resist coating film has shifted to short wavelength side. On top of that, it is getting hard to obtain a stable resolution on these highly reflected materials because the size of the pattern is close to the exposure wavelength.

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Especially when a strong monochromatic light source such as the Excimer laser is used it is necessary to put an antireflection film because Standing Wave Effects change shape or width of wiring of the resist pattern.

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For the antireflection film, the use of a nitrogen oxide silicon (SiON) system thin film attracts a great deal of attention as it can control optic constant. The SiON system thin film can be produced by the plasma CVD method, and it is possible to be applied to the photo lithography using the Excimer laser because the optic constant is controllable by changing hydrogen contents in the film.

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Now, giving an example of an MOS transistor with the antireflection film. As in the chart 6, on a Si substrate 1, element isolation regions 2 and a gate insulation film 3 are formed. A gate electrode 109 constituted by a polysilicon layer 4 and a tungsten silicide layer 105 is formed above the film 3. The antireflection film 7 is formed on top and the sidewalls 10 are formed on both sides of the gate electrode 109. The antireflection film 7 is composed by a SiON system thin film. On the upper part, a SiO system interlayer insulation film 11 and Al system wiring layers 17 are arranged.